

TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371

Attorney's Docket Number  
051480-5017  
U.S. Application No.  
Unassigned  
Priority Date Claimed

09/529010

International Application. No.

International Filing Date

PCT/DE99/02450

5 August 1999

6 August 1998

Title of Invention

PIEZOELECTRIC ACTOR UNIT

Applicants For DO/EO/US

Andreas VOIGT, Claus ZUMSTRULL, Guenter LEWENTZ and Wilhelm FRANK

Applicants herewith submit to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(I).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☒ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ have been transmitted by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventors (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
14. ☐ Translation of the annexes to the International Preliminary Examination Report
15. ☐ A Proposed Substitute specification.
15. ☒ Other items or information:
  - a. Publication No. WO 00/08353 (cover page)
  - b. PCT/ISA/220

Unassigned

PCT/DE99/02450

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527 Rec'd PCT/PTO 06 APR 2000

17. [X] The following fees are submitted:

**Basic National Fee (37 CFR 1.492(a)(1)-(5)):**

Search Report has been prepared by the EPO or JPO.....\$840.00

International preliminary examination fee paid to

USPTO (37 CFR 1.482).....\$670.00

No international preliminary examination fee paid to

USPTO (37 CFR 1.482) but international search fee

paid to USPTO (37 CFR 1.445(a)(2)).....\$760.00

Neither international preliminary examination fee

(37 CFR 1.482) nor international search fee

(37 CFR 1.445(a)(2)) paid to USPTO.....\$970.00

International preliminary examination fee paid to USPTO

(37 CFR 1.482) and all claims satisfied provisions

of PCT Article 33(2)-(4).....\$96.00

**ENTER APPROPRIATE BASIC FEE AMOUNT = \$ 840.00**

Surcharge of \$130.00 for furnishing the oath or declaration later than

[ ] 20 [ ] 30 months from the earliest claimed priority date

(37 CFR 1.492(e)).

\$

Claims	Number Filed	Number Extra	Rate	
Total Claims	19- 20 =	0	X \$18.00	\$
Independent Claims	4- 3 =	1	X \$78.00	\$78.00
Multiple dependent claim(s) (if applicable)			+\$260.00	\$
<b>TOTAL OF ABOVE CALCULATIONS =</b>				<b>\$0.00</b>

Reduction by 1/2 for filing by small entity, if applicable. Verified

Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28)

-\$

**SUBTOTAL = \$918.00**

Processing fee of \$130.00 for furnishing the English translation later

than [ ] 20 [ ] 30 months from the earliest claimed priority date

(37 CFR 1.492(f)).

+\$

**TOTAL NATIONAL FEE = \$**

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The

assignment must be accompanied by an appropriate cover sheet

(37 CFR 3.28, 3.31). \$40.00 per property

+

**TOTAL FEES ENCLOSED = \$918.00**

Amount to be

refunded

\$

charged

\$

- a. [ ] A check in the amount of \$ to cover the above fees is enclosed.
- b. [X] Please charge my Deposit Account No. 50-0310 in the amount of \$918.00 to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. [X] **Except** for issue fees payable under 37 C.F.R. §1.18, the Commissioner is hereby authorized by this paper to charge any additional fees during the entire pendency of this application including fees due under 37 CFR §1.16 and §1.17 which may be required, or credit any overpayment to Deposit Account No. 50-0310.

**SEND ALL CORRESPONDENCE TO:****Morgan, Lewis & Bockius LLP****1800 M Street, N.W.****Washington, D.C. 20036****(202) 467-7000**

for Scott J. Anchell

Reg. No. 35,035

Submitted: April 6, 2000

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of: VOIGT et al.	)	
	)	
Application No.: not yet assigned	)	Group Art Unit: not yet assigned
	)	
Filed: herewith	)	Examiner: not yet assigned
	)	
Title: PIEZOELECTRIC ACTOR UNIT	)	

**PRELIMINARY AMENDMENT**

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

Prior to the examination of the above-identified application on the merits, please  
amend the application as follows:

**IN THE CLAIMS:**

Please amend claims 4-10 as follows:

Claim 4, line 1, change "claim 1 or 2 or hollow body according to claim 3," to --claim  
1,--.

Claim 5, line 1, change "claim 1, 2 or 4, or hollow body according to claim 3 or 4," to  
--claim 1,--.

Claim 6, line 1, change "claim 1, 2, 4 or 5, or hollow body according to any one of  
claims 3 to 5," to --claim 1,--.

Claim 7, line 1, change "claim 1, 2, 4 to 6 or hollow body according to any one of  
claims 3 to 6," to --claim 1,--.

Claim 8, line 1, change "claim 1, 2, 4 to 7 or hollow body according to any one of  
claims 3 to 7," to --claim 1,--.

Claim 9, line 1, change "claim 1, 2, 4 to 8 or hollow body according to any one of claims 3 to 8," to --claim 1,--.

Claim 10, line 1, change "claim 1, 2, 4 to 9 or hollow body according to any one of claims 3 to 9," to --claim 1,--.

Please insert new claims 13-19 as follows:

--13. Hollow body according to claim 3, characterized in that the holes are arranged in rows one above the other, the holes of the rows being laterally offset from one another.

14. Hollow body according to claim 3, characterized in that the minimum distance between adjacent holes (41) of two rows is one or three times the wall thickness of the hollow body (4).

15. Hollow body according to claim 3, characterized in that the holes (41) are distributed uniformly over the circumference of the hollow body (4).

16. Hollow body according to claim 3, wherein the hollow body (4) is made of spring steel and the holes (41) are punched.

17. Hollow body according to claim 3, characterized in that the hollow body (4) has at least one weld seam which joins together two abutting edges of the hollow body.

18. Hollow body according to claim 3, characterized in that the hollow body (4) has two abutment edges which are associated with one another and extend over the entire length of the hollow body.

19. Hollow body according to claim 3, characterized in that the marginal areas of the holes (41) are at least partially compressed.--.

**REMARKS**

This Preliminary Amendment is being filed in order to eliminate the surcharge for multiple dependent claims. Claims 4-10 have been amended and new claims 13-19 have been added. Claims 1-19 are submitted for examination.

Applicant respectfully submits that no new matter has been added by this Preliminary Amendment. Entry of the above amendment is respectfully requested.

If there is any fee due in connection with the filing of this Preliminary Amendment, please charge the fees to our Deposit Account No. 50-0310.

Respectfully submitted,  
**MORGAN, LEWIS & BOCKIUS LLP**

Dated: 6 April 2000

By: Scott J. Anchell

Scott J. Anchell  
Reg. No. 35,035

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4/PRTB

09/529010  
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Attorney Docket No. 051480-5017

### **Piezoelectric Actor Unit**

The invention relates to an actor unit with a piezoelectric actor disposed in a hollow body, according to the preamble of claim 1, and a hollow body for biasing a piezoelectric actor according to the preamble of claim 3.

Actor units with a piezoelectric actor which is biased by a resilient hollow body are used, for example, in automotive technology to control injection valves in an internal combustion engine. DE 38 44 134 C2 discloses an injection valve which is operated by a piezoelectric actor which is arranged in a cylindrical tubular spring and is biased by the latter against the casing of the injection valve. This design of the actor unit has, however, the disadvantage that the biasing of the piezoelectric actor depends greatly on the manufacturing tolerances of the casing of the injection valve. Furthermore, the installation of the actor unit is complicated and requires a great amount of maintenance, since upon each installation and removal the bias applied to the piezoelectric actor by the tubular spring has to be reset. Furthermore, in the case of the tubular springs used the problem also is that, in order to achieve sufficient elasticity for the longitudinal movement of the piezoelectric actor, the tubular springs must be made with an extremely thin wall, which impairs their strength and with it the useful life of the actor unit.

The present invention is addressed to the problem of creating an actor unit with a piezoelectric actor which is suitable especially for the control of fuel injection valves and is characterized by simple manufacture, ease of installation, great ease of maintenance and long useful life, as well as by a hollow body for biasing the piezoelectric actor in such an actor unit.

This problem is solved in an actor unit by the features of claim 1 and in a hollow body for biasing a piezoelectric actor, by the features of claim 3.

In the actor unit according to the invention a piezoelectric actor is strongly biased, so that the entire component can be pre-manufactured and is furthermore easy to install, for example, in an internal combustion engine, and no retightening of the piezoelectric actor will be necessary. The design of the hollow body biasing the piezoelectric actor according to the invention with holes that are dumb-bell shaped also assures that the hollow body will have sufficient strength also at the biases usually applied to the piezoelectric actor of 800 N to 1000 N, and at the same time will be sufficiently elastic to perform the longitudinal movement produced by the piezoelectric actor.

It is advantageous especially to design the holes on the hollow body so that the minimum distance between adjacent holes will be one to three times the wall thickness of the hollow body, which especially offers the possibility for a simple and hence inexpensive punching of the holes. Additional advantageous embodiments of the actor unit and of the hollow body are disclosed in the dependent claims.

The invention is further explained with the aid of the drawing, wherein:

Fig. 1 is a side view of an actor unit according to the invention,

Fig. 2A an embodiment of a hollow body according to the invention for biasing a piezoelectric actor as a tubular spring,

Fig. 2B a sectional view along line A-A in the tubular spring of Fig. 2A,

Fig. 2C the tubular spring of Fig. 2A represented in the unrolled state,

Fig. 2D a represented of the detail X of Fig. 2C, and

Fig. 3 a punching arrangement.

Fig. 1 shows in cross section an actor unit consisting of a piezoelectric actor 1 which can be composed of a plurality of stacked piezoelectric single elements. The piezoelectric actor 1 is operated through contact pins 2 which are arranged along the actor and are in conductive connection with the actor. By applying a voltage between the contact pins 2 a lengthwise expansion of the piezoelectric actor 1 is produced, which can be utilized for operating an injection valve in an internal combustion engine. The piezoelectric actor 1 with the contact pins 2 is disposed in a hollow body 4 configured as a tubular spring. The hollow body 4, however, can have, instead of the circular cross section represented, a rectangular profile, the shape of the hollow body being adapted to the component consisting of piezoelectric actor and contact pins.

The piezoelectric actor 1 is in contact at its end faces with cover plates 5 and 6, the upper cover plate 6 having bores 61 through which the contact pins 2 extend. The top and bottom cover plates 5 and 6 are tensionally or positively joined to the hollow body 4, preferably by welding. Alternatively, the joining between the hollow body 4 and the two cover plates 5 and 6 can be accomplished by beading, with the beaded upper and lower margins of the hollow body embedded into the cover plates. The piezoelectric actor 1 is biased with a defined force of preferably 800 N to 1000 N by the two cover plates 5 and 6, which are held in position by the hollow body 4. To be able to sustain this bias, the hollow body receiving the piezoelectric actor is made preferably from spring steel which is distinguished by a high strength characteristic. Alternatively, however, other materials can be used, e.g., materials with a low elasticity modulus, such as copper-beryllium alloys, for example.

Figs. 2A to 2D show more precisely the construction of the hollow body 4 in the form of a tubular spring. The tubular spring has holes 41 uniformly distributed over its entire surface except for the marginal areas to which the cover plates are welded, and they are of a "dumb-bell" shape and run through the tubular spring at right angles to the axis. The holes 41 assure the sufficient elasticity of the tubular spring receiving a biased piezoelectric actor, so that the tubular spring interferes but negligibly with the elongation caused by the piezoelectric actor. The elasticity of the tubular spring can be adapted by the number and length of the holes 41 to the desired elongation of the biased piezoelectric actor.

Also advantageous is the arrangement in rows of the holes 41 one over the other, shown in Figs. 2A, 2C and 2D, wherein the individual rows are staggered in the manner of a slide fastener. In this case the holes 41 of adjacent rows are offset from one another, so that the circular end areas are all on one line and slots of the holes are opposite one another only in every other row. This arrangement assures sufficient elasticity to apply the bias to the piezoelectric actor. The elasticity is supported especially also by the "dumb-bell"-like shape of the holes 41, in which two circular holes are connected together by a slot. Preferred size ranges are from 0.8 to 1.6 mm in diameter in the case of the circular holes, and the intervals between the centers of the holes are in the range of 1.5 to 3.5 mm. This form can furthermore be achieved very simply and precisely by punching them, for example, in a sheet of spring steel. For production reasons it is furthermore advantageous if the minimum distance between adjacent holes 41 is one to three times the wall thickness of the tubular spring.

The tubular spring is preferably made from a spring steel strip with a thickness of 0.5 mm. In a first step the holes are punched into the spring steel strip. Alternatively, it is also possible to form the holes by wire erosion, milling, drilling, or by electrochemical methods. Preferably too the marginal area around the holes is slightly bent plastically so that a strengthening of the spring steel strip is accomplished by the inherent tension thus created. This can be achieved, for example, if the punch with which the holes are made is expanded to a larger cross section after performing the punching action, so that a thickening of the marginal areas of the holes is created. In this case, furthermore, a slight bending of the burr around the holes out of the plane of the strip can occur. The marginal areas of the holes can also be strengthened by air-blasting the strip with beads.

After the holes 41 are made the spring steel strip is cut to the measure desired for the tubular spring, the holes being preferably designed, as shown in Fig. 2D, so that the cut passes through their center at the abutment edges. Then the cut piece is rolled, with the cut or punched edges on the outer side. Then the edges are deburred and the tubular form is completed by longitudinal welding with a laser. To further improve the strength of the tubular spring a heat treatment can then also be performed. As an alternative to the rectilinear abutment edges of the tubular spring, however, the abutting cut edges can be of any desired shape, e.g., the shape of a sine wave or a sawtooth shape, a correspondingly shaped weld seam being created to complete the tubular spring.

Instead of completing the tubular form by welding, the cut edges can be held together by the top and bottom cover plates 5 and 6, so that the cut edges just touch one another. This results in an advantageous distribution of the pressures and spring forces in the hollow body.

The formation of the actor unit with an external hollow body, which is preferably in the form of a tubular spring, and in which the piezoelectric actor is fixed tensionally and/or positively to the hollow body, makes it easy to package owing to its compact design and easy to install and remove in an internal combustion engine, for example, for the control of injection valves. The formation of "dumb-bell" shaped holes running transversely of the axis of the hollow body permits an optimum adjustment of the elasticity of the hollow body to the desired longitudinal movement of the piezoelectric actor and simultaneously a simplified production



of the hollow body.

Figure 3 shows schematically an arrangement for creating an hole 73 in a spring steel strip 71 by punching. A punch 70 is provided, which punches a hole 73 into the spring steel strip 71 lying on a die 72. Thus a piece of the spring steel strip is forced through an hole 74 in the die 72.

Due to the punching, the hole 73 has on its bottom U facing the die 72 a greater surface area D1 than on the upper side O into which the punch 70 first penetrates. In addition, the punch produces a burr 74 on the bottom U surrounding the hole 73.

The different sizes of the areas D1 and D2 of the hole 73 on the upper side O and bottom side U and/or the burr 74 result in a difference in the stiffness, hardness and spring property on the upper side O in comparison to the bottom side U of the spring steel strip 71. This is disadvantageous to uniform pressure distribution and impairs the long-term stability of the tubular spring.

To reduce these inhomogeneities it is advantageous when making a tubular spring as in Figures 2a and 2b to close the spring steel strip such that the upper side O is on the outer side of the tubular spring and the bottom side U on the inner side of the tubular spring.

With the described manner of manufacture, the surfaces D1 and D2 of the hole 73, which are different after punching, are matched to one another since the smaller area D2 is expanded on the outside by the bending and is thus enlarged, and the larger area D1 is upset and thus reduced. Thus the inhomogeneities created in the spring steel strip by the punching process are reduced.

## Claims

1. Actor unit with a piezoelectric actor (1) disposed in a hollow body (4), the hollow body being elastic and biasing the actor, characterized in that the hollow body (4) is joined tensionally and/or positively to the upper and lower end of the actor, the hollow body being provided with holes (41) which are of a dumb-bell shape and run transversely of the hollow body's axis.
2. Actor unit according to claim 1, characterized in that the piezoelectric actor (1) is gripped in its direction of expansion between an upper and a lower cover plate (5, 6) which are tensionally and/or positively joined to the hollow body.
3. Hollow body for biasing a piezoelectric actor, the hollow body being made elastic, characterized in that the hollow body is provided with holes (41) which are of a dumb-bell shape and run transversely of the hollow body's axis.
4. Actor unit according to claim 1 or 2 or hollow body according to claim 3, characterized in that the holes are arranged in rows one above the other, the holes of the rows being laterally offset from one another.
5. Actor unit according to any one of claims 1, 2 or 4, or hollow body according to claim 3 or 4, characterized in that the minimum distance between adjacent holes (41) of two rows is one or three times the wall thickness of the hollow body (4).
6. Actor unit according to any one of claims 1, 2, 4 or 5, or hollow body according to any one of claims 3 to 5, characterized in that the holes (41) are distributed uniformly over the circumference of the hollow body (4).
7. Actor unit according to any one of claims 1, 2, 4 to 6 or hollow body according to any one of claims 3 to 6, wherein the hollow body (4) is made of spring steel and the holes (41) are punched.
8. Actor unit according to any one of claims 1, 2, 4 to 7 or hollow body according to any one of claims 3 to 7, characterized in that the hollow body (4) has at least one weld seam which joins together two abutting edges of the hollow body.
9. Actor unit according to any one of claims 1, 2, 4 to 8 or hollow body according to any one of claims 3 to 8, characterized in that the hollow body (4) has two abutment edges which are associated with one another and extend over the entire length of the hollow body.
10. Actor unit according to any one of claims 1, 2, 4 to 9 or hollow body according to any one of claims 3 to 9, characterized in that the marginal areas of the holes (41) are at least partially compressed.

11. Elastic hollow body for biasing an actor (1), the hollow body being made from a flat (71) into which holes (73) are made by punching, characterized in that the side (A) of the flat into which a punch (70) has penetrated in the stamping operation is disposed on the outer side of the hollow body.

12. Method for the production of an elastic hollow body for biasing an actor (1), by the following process steps:

- a hole (73) is made in a flat (71) with a punch (70),
- the punch (70) penetrates into the flat (71) on the upper side (A) of the flat and punches out a portion of the flat on the underside (B),
- the flat (71) lying on a die (72),
- then the flat (71) is formed into a sleeve and edges in contact with one another are joined,
- characterized in that,
- upon the forming of the sleeve the upper side (A) is disposed on the outer side and the bottom (B) of the flat (71) is disposed on the inner side of the sleeve.

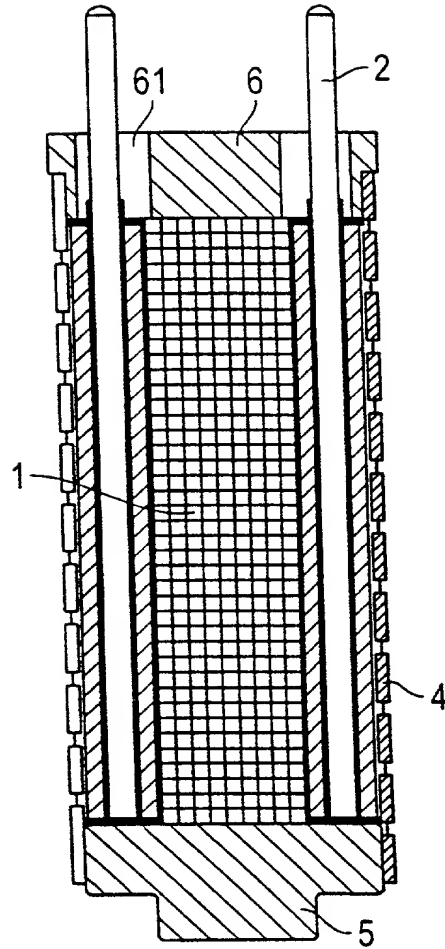
### **Abstract**

An actor unit has an elastically configured hollow body in which a piezoelectric actor is biased, the hollow body being provided with holes which are of a dumb-bell shape and run transversely of the hollow body's axis.

1. An actor unit comprising a hollow body elastically configured to expand and contract, a piezoelectric actor biased to expand and contract, and a plurality of dumb-bell shaped holes running transversely of the hollow body's axis, the dumb-bell shaped holes being formed in the hollow body.

1/4

FIG 1



2/4

FIG 2A

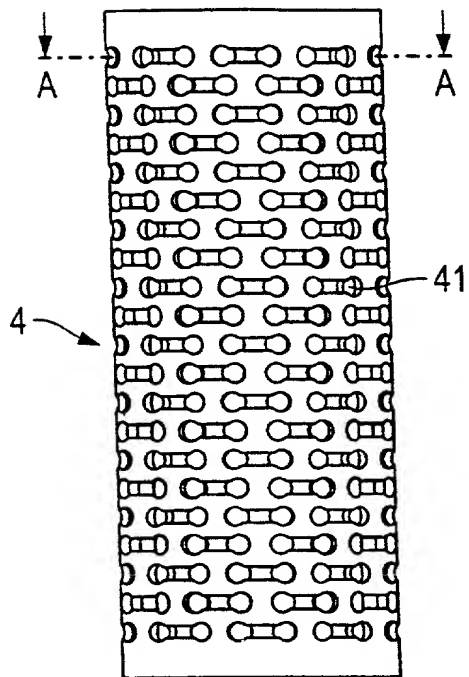
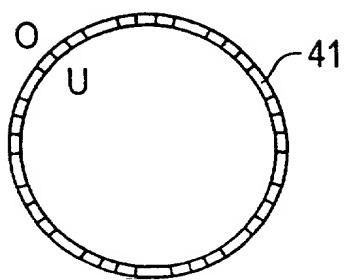


FIG 2B



Section A-A

3/4

FIG 2C

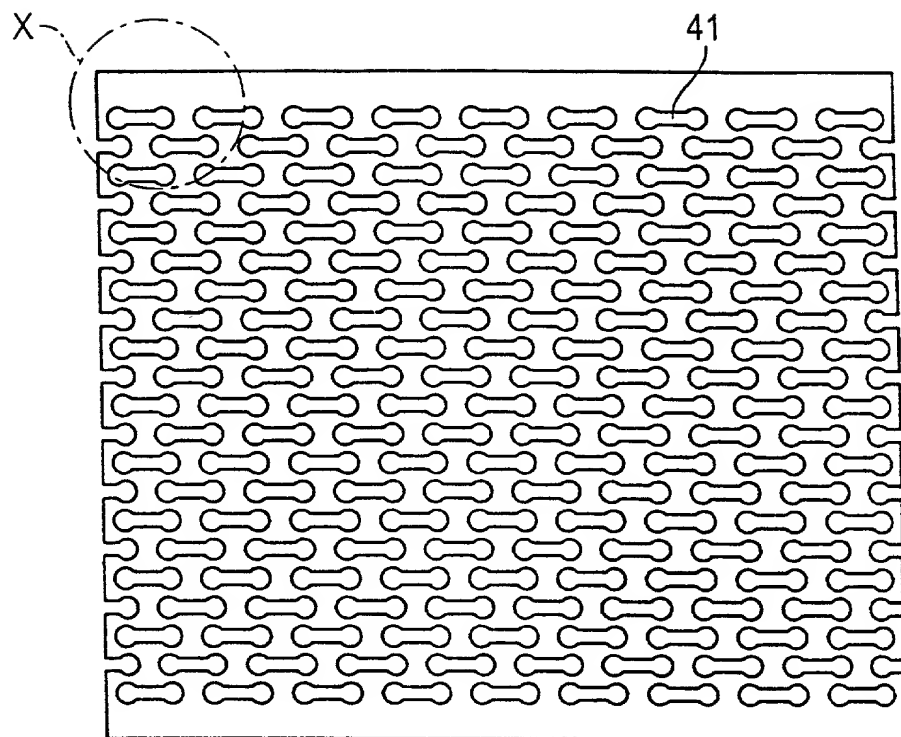
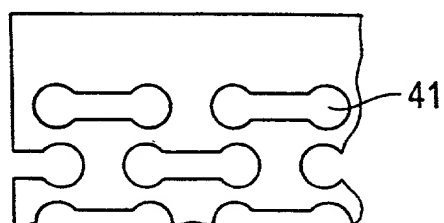
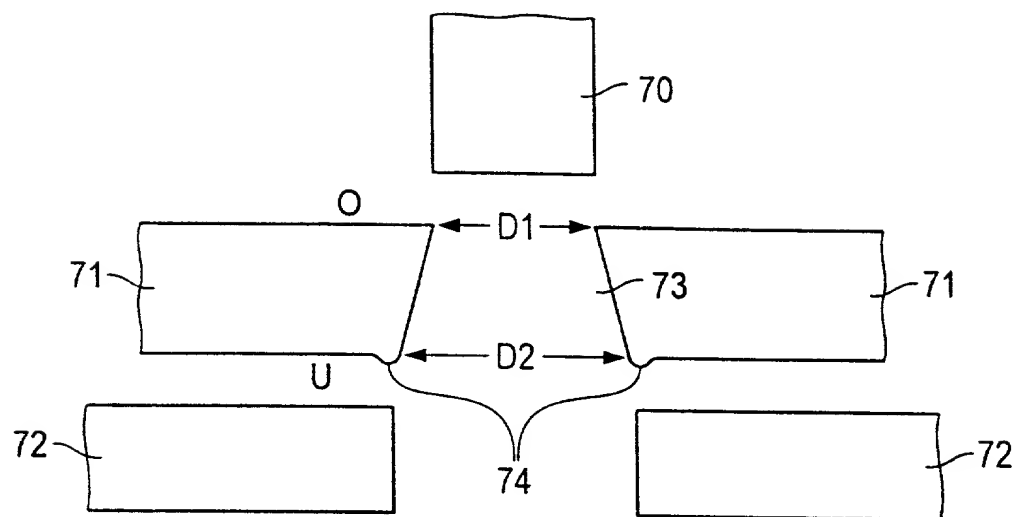


FIG 2D



Detail X

FIG 3





Attorney Docket No 051480-5017

## Declaration and Power of Attorney for Patent Application Erklärung für Patentanmeldungen mit Vollmacht

### German Language Declaration

Als nachstehend benannter Erfinder erkläre ich  
hiermit an Eides Statt:

daß mein Wohnsitz, meine Postanschrift und meine  
Staatsangehörigkeit den im nachstehenden nach  
meinem Namen aufgeführten Angaben  
entsprechen, daß ich nach bestem Wissen der  
ursprüngliche, erste und alleinige Erfinder (falls  
nachstehend nur ein Name angegeben ist) oder ein  
ursprünglicher, erster und Miterfinder (falls  
nachstehend mehrere Namen aufgeführt sind) des  
Gegenstandes bin, für den dieser Antrag gestellt  
wird und für den ein Patent für die Erfindung mit  
folgendem Titel beantragt wird:

PIEZOELECKTRISCHE AKTOREINHEIT

deren Beschreibung hier beigelegt ist, es sei denn  
(in diesem Falle Zutreffendes bitte ankreuzen),  
diese Erfindung

☒ wurde angemeldet  
am

6 April 2000

unter der US-Anmeldenummer oder unter der  
Internationalen Anmeldenummer im Rahmen  
des Vertrags über die Zusammenarbeit auf  
dem Gebiet des Patentwesens (PCT)

09/529,010 und am  
abgeändert (falls zutreffend).

Ich bestätige hiermit, daß ich den Inhalt der oben  
angegebenen Patentanmeldung, einschließlich der  
Ansprüche, die eventuell durch einen oben  
erwähnten Zusatzantrag abgeändert wurde,  
durchgesehen und verstanden habe.

Ich erkenne meine Pflicht zur Offenbarung  
jeglicher Informationen an, die zur Prüfung der  
Patentfähigkeit in Einklang mit Titel 37, Code of  
Federal Regulations, § 1.56 von Belang sind.

As a below named inventor, I hereby declare that.

My residence, post office address and citizenship are  
as stated below next to my name

I believe I am the original, first and sole inventor (if  
only one name is listed below) or an original, first  
and joint inventor (if plural names are listed below)  
of the subject matter which is claimed and for which  
a patent is sought on the invention entitled:

PIEZOELECTRIC ACTOR UNIT

the specification of which is attached hereto unless  
the following box is checked:

☒ was filed on 6 April 2000 as United

States Application Number or PCT International  
Application Number 09/529,010 and  
was amended on \_\_\_\_\_ (if  
Applicable).

I hereby state that I have reviewed and understand  
the contents of the above-identified specification,  
including the claims, as amended by any amendment  
referred to above.

I acknowledge the duty to disclose to the U.S. Patent  
and Trademark Office information which is material  
to the patentability of claims presented in this  
application in accordance with Title 37, Code of  
Federal Regulations, § 1.56.

Attorney Docket No 051480-5017

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäß Title 35, US-Code, § 119 (a)-(d), bzw. § 365(b) aller unten aufgeführten Auslandsanmeldungen für Patente oder Erfinderurkunden, oder § 365(a) aller PCT internationalen Anmeldungen, welche wenigstens ein Land ausser den Vereinigten Staaten von Amerika benennen, und habe nachstehend durch ankreuzen sämtliche Auslandsanmeldungen für Patente bzw. Erfinderurkunden oder PCT internationale Anmeldungen angegeben, deren Anmeldetag dem der Anmeldung, für welche Priorität beansprucht wird, vorangeht.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate or § 365(a) of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

Prior Foreign Applications  
(Frühere ausländische Anmeldungen)

19835628.5 (Number) (Nummer)	Germany (Country) (Land)	6 August 1998 (Day/Month/Year Filed) (Tag/Monat/Jahr der Anmeldung)	<input type="checkbox"/> Priority Not Claimed Priorität nicht beansprucht
_____ (Number) (Nummer)	_____ (Country) (Land)	_____ (Day/Month/Year Filed) (Tag/Monat/Jahr der Anmeldung)	<input type="checkbox"/> Priority Not Claimed Priorität nicht beansprucht
_____ (Number) (Nummer)	_____ (Country) (Land)	_____ (Day/Month/Year Filed) (Tag/Monat/Jahr der Anmeldung)	<input type="checkbox"/> Priority Not Claimed Priorität nicht beansprucht

Ich beanspruche hiermit Prioritätsvorteile unter Title 35, US-Code, § 119(e) aller US-Hilfsanmeldungen wie unten aufgezählt.

I hereby claim the benefits under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below.

Provisional Applications  
(Hilfsanmeldungen)

_____ (Application No.) (Aktenzeichen)	_____ (Filing Date) (Anmeldetag)
_____ (Application No.) (Aktenzeichen)	_____ (Filing Date) (Anmeldetag)
_____ (Application No.) (Aktenzeichen)	_____ (Filing Date) (Anmeldetag)

Ich beanspruche hiermit die mir unter Title 35, US-Code, § 120 zustehenden Vorteile aller unten aufgeführten US-Patentanmeldungen bzw. § 365(c) aller PCT internationalen Anmeldungen, welche die Vereinigten Staaten von Amerika benennen, und

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) or § 365(c) of any PCT international application(s) designating the United States of America that is/are listed below and, insofar as the

Attorney Docket No 051480-5017

früheren Anspruchs dieser Patentanmeldung nicht in einer US-Patentanmeldung, bzw. PCT internationalen Anmeldung in einer gemäß dem ersten Absatz von Title 35, US-Code, § 112 vorgeschriebenen Art und Weise offenbart wurde, meine Pflicht zur Offenbarung jeglicher Informationen an, die zur Prüfung der Patentfähigkeit in Einklang mit Title 37, Code of Federal Regulations, § 1.56 von Belang sind und die im Zeitraum zwischen dem Anmeldetag der früheren Patentanmeldung und dem nationalen oder im Rahmen des Vertrags über die Zusammenarbeit auf dem Gebiet des Patentwesens (PCT) gültigen internationalen Anmeldetags bekannt geworden sind.

application is not disclosed in that those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, § 112. I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to the patentability of claims presented in this application in accordance with Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application(s) and the national or PCT international filing date of this application.

Prior U.S. Applications and PCT International Applications Designating the U.S.  
(US-Patentanmeldungen und PCT internationalen Anmeldungen, welche die US benennen)

PCT/DE99/02450 (Application No.) (Aktenzeichen)	5 August 1999 (Filing Date) (Anmeldetag)	Pending (Status) (patented, pending, abandoned) (Status) (patentiert, schwebend, aufgegeben)
(Application No.) (Aktenzeichen)	(Filing Date) (Anmeldetag)	(Status) (patented, pending, abandoned) (Status) (patentiert, schwebend, aufgegeben)
(Application No.) (Aktenzeichen)	(Filing Date) (Anmeldetag)	(Status) (patented, pending, abandoned) (Status) (patentiert, schwebend, aufgegeben)

VERTRETUNGSVOLMACHT: Als benannter Erfinder beauftrage ich hiermit eingeschrieben Praktiker Morgan, Lewis & Bockius LLP eingeschlossen ein Kunde Nummer beliefert unten mit der Verfolgung der vorliegenden Patentanmeldung sowie mit der Abwicklung aller damit verbundenen Angelegenheiten vor dem US-Patent und Markenamt. Gesamt korrespondenz sollte sein adressiert zur das Kunde Nummer.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the registered practitioners of Morgan, Lewis & Bockius LLP included in the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith. All correspondence should be addressed to that Customer Number.

Customer Number (Kunde Nummer) 009629

Postanschrift:

Send Correspondence to:

David W. Laub

Telefonische Auskünfte: (Name und Telefonnummer)

Direct Telephone Calls to: (name and telephone number)

David W. Laub (215-963-5355)

Attorney Docket No. 051480-5017

## Declaration and Power of Attorney for Patent Application Erklärung für Patentanmeldungen mit Vollmacht

### German Language Declaration

Als nachstehend benannter Erfinder erkläre ich  
hiermit an Eides Statt:

daß mein Wohnsitz, meine Postanschrift und meine  
Staatsangehörigkeit den im nachstehenden nach  
meinem Namen aufgeführten Angaben  
entsprechen, daß ich nach bestem Wissen der  
ursprüngliche, erste und alleinige Erfinder (falls  
nachstehend nur ein Name angegeben ist) oder ein  
ursprünglicher, erster und Miterfinder (falls  
nachstehend mehrere Namen aufgeführt sind) des  
Gegenstandes bin, für den dieser Antrag gestellt  
wird und für den ein Patent für die Erfindung mit  
folgendem Titel beantragt wird:

PIEZOELECKTRISCHE AKTOREINHEIT

deren Beschreibung hier beigelegt ist, es sei denn  
(in diesem Falle Zutreffendes bitte ankreuzen),  
diese Erfindung

☒ wurde angemeldet  
am

6 April 2000

unter der US-Anmeldenummer oder unter der  
Internationalen Anmeldenummer im Rahmen  
des Vertrags über die Zusammenarbeit auf  
dem Gebiet des Patentwesens (PCT)  
09/529,010 und am  
abgeändert (falls zutreffend).

Ich bestätige hiermit, daß ich den Inhalt der oben  
angegebenen Patentanmeldung, einschließlich der  
Ansprüche, die eventuell durch einen oben  
erwähnten Zusatzantrag abgeändert wurde,  
durchgesehen und verstanden habe.

Ich erkenne meine Pflicht zur Offenbarung  
jeglicher Informationen an, die zur Prüfung der  
Patentfähigkeit in Einklang mit Titel 37, Code of  
Federal Regulations, § 1.56 von Belang sind.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are  
as stated below next to my name.

I believe I am the original, first and sole inventor (if  
only one name is listed below) or an original, first  
and joint inventor (if plural names are listed below)  
of the subject matter which is claimed and for which  
a patent is sought on the invention entitled:

PIEZOELECTRIC ACTOR UNIT

the specification of which is attached hereto unless  
the following box is checked:

☒ was filed on 6 April 2000 as United

States Application Number or PCT International  
Application Number 09/529,010 and  
was amended on \_\_\_\_\_ (if  
Applicable).

I hereby state that I have reviewed and understand  
the contents of the above-identified specification,  
including the claims, as amended by any amendment  
referred to above.

I acknowledge the duty to disclose to the U.S. Patent  
and Trademark Office information which is material  
to the patentability of claims presented in this  
application in accordance with Title 37, Code of  
Federal Regulations, §1.56.

Attorney Docket No. 051480-5017

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäß Title 35, US-Code, § 119 (a)-(d), bzw. § 365(b) aller unten aufgeführten Auslandsanmeldungen für Patente oder Erfinderurkunden, oder § 365(a) aller PCT internationalen Anmeldungen, welche wenigstens ein Land ausser den Vereinigten Staaten von Amerika benennen, und habe nachstehend durch ankreuzen sämtliche Auslandsanmeldungen für Patente bzw. Erfinderurkunden oder PCT internationale Anmeldungen angegeben, deren Anmeldetag dem der Anmeldung, für welche Priorität beansprucht wird, vorangeht.

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate or §365(a) of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

Prior Foreign Applications  
(Frühere ausländische Anmeldungen)

19835628.5 (Number) (Nummer)	Germany (Country) (Land)	6 August 1998 (Day/Month/Year Filed) (Tag/Monat/Jahr der Anmeldung)	<input type="checkbox"/> Priority Not Claimed Priorität nicht beansprucht
 (Number) (Nummer)	 (Country) (Land)	 (Day/Month/Year Filed) (Tag/Monat/Jahr der Anmeldung)	<input type="checkbox"/> Priority Not Claimed Priorität nicht beansprucht
 (Number) (Nummer)	 (Country) (Land)	 (Day/Month/Year Filed) (Tag/Monat/Jahr der Anmeldung)	<input type="checkbox"/> Priority Not Claimed Priorität nicht beansprucht

Ich beanspruche hiermit Prioritätsvorteile unter Title 35, US-Code, § 119(e) aller US-Hilfsanmeldungen wie unten aufgezählt.

I hereby claim the benefits under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below.

Provisional Applications  
(Hilfsanmeldungen)

 (Application No.) (Aktenzeichen)	 (Filing Date) (Anmeldetag)
 (Application No.) (Aktenzeichen)	 (Filing Date) (Anmeldetag)
 (Application No.) (Aktenzeichen)	 (Filing Date) (Anmeldetag)

Ich beanspruche hiermit die mir unter Title 35, US-Code, § 120 zustehenden Vorteile aller unten aufgeführten US-Patentanmeldungen bzw. § 365(c) aller PCT internationalen Anmeldungen, welche die Vereinigten Staaten von Amerika benennen, und erkenne, insofern der Gegenstand eines jeden

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) or § 365(c) of any PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this

Attorney Docket No. 051480-5017

Ich erkläre hiermit, daß alle in der vorliegenden Erklärung von mir gemachten Angaben nach bestem Wissen und Gewissen der Wahrheit entsprechen, und ferner daß ich diese eidesstattliche Erklärung in Kenntnis dessen ablege, daß wissentlich und vorsätzlich falsche Angaben oder dergleichen gemäß § 1001, Title 18 des US-Code strafbar sind und mit Geldstrafe und/oder Gefängnis bestraft werden können und daß derartige wissentlich und vorsätzlich falsche Angaben die Rechtswirksamkeit der vorliegenden Patentanmeldung oder eines aufgrund deren erteilten Patenten gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Vor- und Zuname des einzigen oder ersten Erfinders:		Full name of sole or first inventor:	
Andreas VOIGT		Andreas VOIGT	
Unterschrift des Erfinders	Datum:	Inventor's signature:	Date:
Wohnsitz: Regensburg, Bundesrepublik Deutschland		Residence: Regensburg, Federal Republic of Germany	
Staatsangehörigkeit: Deutsche		Citizenship: German	
Postanschrift: Liebigstrasse 27 D-93055 Regensburg, Bundesrepublik Deutschland		Post Office Address: Liebigstrasse 27 D-93055 Regensburg, Federal Republic of Germany	
Vor- und Zuname des zweiten Miterfinders (falls zutreffend): Wilhelm FRANK		Full name of second inventor, if any: Wilhelm FRANK	
Unterschrift des zweiten Erfinders:	Datum:	Second inventor's signature:	Date:
<i>Wilhelm Frank</i>	11.11.00		
Wohnsitz: Bamberg, Bundesrepublik Deutschland		Residence: Bamberg, Federal Republic of Germany	
Staatsangehörigkeit: Deutsche		Citizenship: German	
Postanschrift: Meinhardtstrasse 44 D-96049 Bamberg, Bundesrepublik Deutschland		Post Office Address: Meinhardtstrasse 44 D-96049 Bamberg, Federal Republic of Germany	
Vor- und Zuname des dritten Miterfinders (falls zutreffend): Günter LEWENTZ		Full name of third inventor, if any: Günter LEWENTZ	
Unterschrift des dritten Erfinders:	Datum:	Third inventor's signature:	Date:
Wohnsitz: Regensburg, Bundesrepublik Deutschland		Residence: Regensburg, Federal Republic of Germany	
Staatsangehörigkeit: Deutsche		Citizenship: German	
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(Im Falle vierter und weiterer Miterfinder sind die entsprechenden

(Supply similar information and signature for fourth and subsequent

Attorney Docket No. 051480-5017

Ich erkläre hiermit, daß alle in der vorliegenden Erklärung von mir gemachten Angaben nach bestem Wissen und Gewissen der Wahrheit entsprechen, und ferner daß ich diese eidessstattliche Erklärung in Kenntnis dessen ablege, daß wissentlich und vorsätzlich falsche Angaben oder dergleichen gemäß § 1001, Title 18 des US-Code strafbar sind und mit Geldstrafe und/oder Gefängnis bestraft werden können und daß derartige wissentlich und vorsätzlich falsche Angaben die Rechtswirksamkeit der vorliegenden Patentanmeldung oder eines aufgrund deren erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Vor- und Zuname des einzigen oder ersten Erfinders: <b>Andreas VOIGT</b>		Full name of sole or first inventor: <b>Andreas VOIGT</b>	
Unterschrift des Erfinders: <i>h. Voigt</i>	Datum: <b>13. Nov. 2000</b>	Inventor's signature:	Date:
Wohnsitz: <b>Regensburg, Bundesrepublik Deutschland</b>		Residence: <b>Regensburg, Federal Republic of Germany</b>	
Staatsangehörigkeit: <b>Deutsche</b> <i>DEX</i>		Citizenship: <b>German</b>	
Postanschrift: <b>Liebigstrasse 27 D-93055 Regensburg, Bundesrepublik Deutschland</b>		Post Office Address: <b>Liebigstrasse 27 D-93055 Regensburg, Federal Republic of Germany</b>	
Vor- und Zuname des zweiten Miterfinders (falls zutreffend): <b>Wilhelm FRANK</b>		Full name of second inventor, if any: <b>Wilhelm FRANK</b>	
Unterschrift des zweiten Erfinders:	Datum:	Second inventor's signature:	Date:
Wohnsitz: <b>Bamberg, Bundesrepublik Deutschland</b>		Residence: <b>Bamberg, Federal Republic of Germany</b>	
Staatsangehörigkeit: <b>Deutsche</b>		Citizenship: <b>German</b>	
Postanschrift: <b>Meinhardtstrasse 44 D-96049 Bamberg, Bundesrepublik Deutschland</b>		Post Office Address: <b>Meinhardtstrasse 44 D-96049 Bamberg, Federal Republic of Germany</b>	
Vor- und Zuname des dritten Miterfinders (falls zutreffend): <b>Günter LEWENTZ</b>		Full name of third inventor, if any: <b>Günter LEWENTZ</b>	
Unterschrift des dritten Erfinders: <i>Günter Lewentz</i>	Datum: <b>15. 11. 00</b>	Third inventor's signature:	Date:
Wohnsitz: <b>Regensburg, Bundesrepublik Deutschland</b>		Residence: <b>Regensburg, Federal Republic of Germany</b>	
Staatsangehörigkeit: <b>Deutsche</b> <i>DEX</i>		Citizenship: <b>German</b>	
Postanschrift: <b>Lärchenweg 5 D-93055 Regensburg, Bundesrepublik Deutschland</b>		Post Office Address: <b>Lärchenweg 5 D-93055 Regensburg, Federal Republic of Germany</b>	

(Im Falle viierter und weiterer Miterfinder sind die entsprechenden Informationen und Unterschriften hinzuzufügen.)

(Supply similar information and signature for fourth and subsequent joint inventors.)

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AN:00012159635299 SEITE:06  
AN:+49 89 636 83723 SEITE:01  
AN:+49 941 7905422 SEITE:01

1998 P02266201

Name und Vorname des Erfinders (hier: Erfinders (falls zutreffend))		Full name of fourth inventor, if any.	
Claus ZIMMSTRULL		Claus ZIMMSTRULL	
Datum: 27.11.00		Date:	
Unterschrift: <i>[Signature]</i>		Fourth inventor's signature:	
Wohnort: Regensburg, Bundesrepublik Deutschland		Residence: Regensburg, Federal Republic of Germany	
Staatsangehörigkeit: Deutsche		Citizenship: German	
Post Office Address: 93102 Regensburg, D-93102 Regensburg, Bundesrepublik Deutschland		Post Office Address: Sattelbogener Strass 20 D-93102 Regensburg, Federal Republic of Germany	
Name und Vorname des fünften Erfinders (falls zutreffend)		Full name of fifth inventor, if any.	
Datum:		Date:	
Unterschrift:		Fifth inventor's signature:	
Wohnort:		Residence:	
Staatsangehörigkeit:		Citizenship:	
Post Office Address:		Post Office Address:	
Name und Vorname des sechsten Erfinders (falls zutreffend)		Full name of sixth inventor, if any.	
Datum:		Date:	
Unterschrift:		Sixth inventor's signature:	
Wohnort:		Residence:	
Staatsangehörigkeit:		Citizenship:	
Post Office Address:		Post Office Address:	
Name und Vorname des siebten Erfinders (falls zutreffend)		Full name of seventh inventor, if any.	
Datum:		Date:	
Unterschrift:		Seventh inventor's signature:	
Wohnort:		Residence:	
Staatsangehörigkeit:		Citizenship:	
Post Office Address:		Post Office Address:	

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UNIT INFORMATION



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Prior U.S. Applications and PCT International Applications Designating the U.S.  
 (US-Patentanmeldungen und PCT internationalen Anmeldungen, welche die US benennen)

PCT/DE99/02450	5 August 1999	Pending
(Application No.) (Aktenzeichen)	(Filing Date) (Anmeldetag)	(Status) (patented, pending, abandoned) (Status) (patentiert, schwebend, aufgegeben)
(Application No.) (Aktenzeichen)	(Filing Date) (Anmeldetag)	(Status) (patented, pending, abandoned) (Status) (patentiert, schwebend, aufgegeben)
(Application No.) (Aktenzeichen)	(Filing Date) (Anmeldetag)	(Status) (patented, pending, abandoned) (Status) (patentiert, schwebend, aufgegeben)

VERTRIEBUNGSVOLMACHT: Als benannter Erfinder beauftrage ich hiermit eingeschrieben Praktiker Morgan, Lewis & Bockius LLP eingeschlossen ein Kunde Nummer beliefert unten mit der Verfolgung der vorliegenden Patentanmeldung sowie mit der Abwicklung aller damit verbundenen Angelegenheiten vor dem US-Patent und Markenamt. Gesamt korrespondenz sollte sein adressiert zur das Kunde Nummer.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the registered practitioners of Morgan, Lewis & Bockius LLP included in the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith. All correspondence should be addressed to that Customer Number.

Customer Number (Kunde Nummer): 009629

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David W Laub (215-963-5355)

Attorney Docket No. 051480-5017

Vor- und Zuname des vierten Miterfinders (falls zutreffend) <b>Claus ZUMSTRULL</b>		Full name of fourth inventor, if any <b>Claus ZUMSTRULL</b>	
Unterschrift des vierten Erfinders	Datum:	Fourth inventor's signature	Date
Wohnsitz <b>Regensburg, Bundesrepublik Deutschland</b>		Residence: <b>Regensburg, Federal Republic of Germany</b>	
Staatsangehörigkeit <b>Deutsche</b>		Citizenship: <b>German</b>	
Postanschrift <b>Sattelbogener Strasse 20 D-93057 Regensburg, Bundesrepublik Deutschland</b>		Post Office Address <b>Sattelbogener Strass 20 D-93057 Regensburg, Federal Republic of Germany</b>	
Vor- und Zuname des fünften Miterfinders (falls zutreffend)		Full name of fifth inventor, if any	
Unterschrift des fünften Erfinders	Datum:	Fifth inventor's signature	Date
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Staatsangehörigkeit		Citizenship:	
Postanschrift		Post Office Address	
Vor- und Zuname des sechsten Miterfinders (falls zutreffend)		Full name of sixth inventor, if any	
Unterschrift des sechsten Erfinders	Datum:	Sixth inventor's signature	Date
Wohnsitz		Residence:	
Staatsangehörigkeit		Citizenship:	
Postanschrift		Post Office Address	
Vor- und Zuname des siebten Miterfinders (falls zutreffend)		Full name of seventh inventor, if any	
Unterschrift des siebten Erfinders	Datum	Seventh inventor's signature	Date
Wohnsitz		Residence:	
Staatsangehörigkeit		Citizenship:	
Postanschrift		Post Office Address	

(In Falle vierter und weiterer Miterfinder sind die entsprechenden Informationen und Unterschriften hinzuzufügen.)

(Supply similar information and signature for fourth and subsequent joint inventors.)